Caroline Duckworth, Climate Ready, Built Environment
Overheating in homes – stakeholder perspective
Ecobuild, 3 March 2015
Climate Ready Support Service

To help ‘key sectors increase their resilience to climate risks’ by incorporating climate risk management into routine business decision-making

Programme objectives:
- Capacity building
- Awareness and motivation
- Mainstreaming

A support service led by the Environment Agency
Climate Ready Support Service

- Health
- Business
- Built Envt
- Natural Envt.
- Agriculture
- Local Govt
- Infrastructure
Climate Change Risk Assessment

A support service led by the Environment Agency
National Adaptation Programme
Stakeholders and overheating

**Built Environment**
- Social housing providers
- House builders / developers
- Product suppliers

**Health**
- Public Health England
- NHS England
- Sustainable Development Unit

**LocalGovt**
- Elected members
- Officers (e.g. Planning and Env. Health)
- Health and Wellbeing boards
Stakeholder perspective: housing associations

- Stakeholder responsibilities...
  - Provide comfortable homes
  - Meet vulnerable user needs
  - Reduce fuel poverty
- Actions to address overheating....
  - New build – design specifications
  - Retrofit – ‘Decent Homes’ and wider maintenance
  - Monitoring and education

A support service led by the Environment Agency
Stakeholder perspective: housing officers

- Stakeholder responsibilities...
  - Building quality
  - Health and welfare
  - Fuel poverty
- Actions to address overheating...
  - Raise public awareness
  - Identify areas/people at risk
  - Support tenants with complaints and encourage landlords to address problems

ClimateReady

A support service led by the Environment Agency
Stakeholder perspective: health and wellbeing boards

跶 Stakeholder responsibilities...
🕔 Identify local health risks
🕔 Support vulnerable groups
🕔 Build and maintain physical assets

🕔 Actions to address overheating...
🕔 Consider in Joint Strategic Needs Assessments and Joint Health & Wellbeing Strategies
🕔 Address in built assets – new and refurbished
🕔 Public health campaigns/projects
Working with ZCH to help stakeholders to address overheating

- Link evidence to stakeholder needs - motivating messages

A support service led by the Environment Agency
Simple guidance

Simple actions stakeholders can take to understand and address risks
Tackling overheating in homes
Definitions and Thresholds review

Dr Anastasia Mylona CEng MCIBSE
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Overheating in homes

The consequences of climate change are not a problem for future generations – they are an immediate threat. Already, there is growing evidence of overheating in homes. According to the Committee on Climate Change (CCC), one fifth of domestic properties could be overheating, even during a cool summer. Flats, which make up 40% of new dwellings, are especially vulnerable.\(^1\)

By the 2040s, half of all summers are expected to be as hot, if not hotter, than in 2003, when temperatures of up to 38°C led to more than 2,000 excess deaths in the UK. A recent CCC adaptation sub-committee report predicts that annual deaths caused by high UK temperatures will triple to 7,000 on average by the 2050s.\(^2\)

Yet at the same time, we are designing and building for winter energy efficiency.

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*We’ve forgotten how to design for natural ventilation in dwellings – we’ve lost the art*

Michael Swainson

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*Article by Liza Young*

*CIBSE Journal August 2014*
What is overheating?

- Not one definition fits all
- Comfort is subjective
- Depends on both environmental and human factors
- Duration/ timing of high temperatures is important
- Very high temperatures > 35°C lead to **Heat stress**
- No statutory maximum temp in UK building regulations

Image from ZCH *Overheating in homes - Where to Start - An introduction for planners, designers and property owners*, 2013
Why do homes overheat?

- Increasing insulation and airtightness
- Warmer cities
- Internal heat gains
- Design of modern flats:
  - high density
  - low thermal mass
  - single sided
  - large glazing areas
  - lack of effective ventilation
  - lack of secure ventilation
  - pipework gains to corridors

Image from ZCH Overheating in homes - Where to Start - An introduction for planners, designers and property owners, 2013
Impacts of overheating

Overheating can be defined with respect to:

- Thermal Comfort
- Health
- Productivity

Design of buildings is primarily focusing on thermal comfort
2 – Definitions and Thresholds

Design for comfort, health and well being

Outdoor temperature thresholds for London

Daytime maximum outdoor air temperature
Heat-Health Warning Level 3 and 4 trigger (32°C)

Daily maximum outdoor air temperature
Excess heat-related mortality (24.7°C)

Night time maximum outdoor air temperature
Heat-Health Warning Level 3 and 4 trigger (18°C)
2 – Definitions and Thresholds

Design for comfort, health and well being

Indoor temperature thresholds

Indoor air temperature (°C): Use of fans should be avoided (Heatwave Plan for England 2014 )(35°C)

Indoor operative temperature (°C): Overheating in bedrooms in free running dwellings (CIBSE Guide A)(26°C)

Summer indoor temperature (°C) as modelled in SAP Appendix P - High likelihood of high internal temperatures during hot weather (23.5°C)
Design for overheating

Design methodology:

• Definition of overheating and pass/fail criteria

• Calculation algorithm

• Description of a building and its occupancy

• Description of external conditions – weather data
Adaptive comfort model:

- individual’s thermal expectations are determined by their experience of recent outdoor temperatures
- their access to environmental controls

Sets three criteria by which a building can be classed as overheating (based on office based field studies):

- Criterion 1: Hours of Exceedance
- Criterion 2: Daily Weighted Exceedance
- Criterion 3: Upper Limit Temperature
Key messages

• Holistic approach to design of homes – year round performance analysis

• Adaptive comfort model allows for the natural adaptability of humans to be considered and so promotes passive design solutions – needs “customisation” for use in the design of homes

• We need better understanding of health related thresholds as a result of the indoor environment

• We need better understanding of productivity related thresholds (sleep deprivation and ability to work from home)
Tackling overheating in homes
Definitions and Thresholds review

Thank you for listening

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TACKLING OVERHEATING IN HOMES

Nicola O’Connor - Ecobuild

3 March 2015
‘Tackling Overheating in Homes’ project
The Zero Carbon Hub’s working definition of overheating:

The phenomenon of a person experiencing excessive or prolonged high temperatures within their home, resulting from internal and/or external heat gains, which leads to adverse effects on their comfort, health or productivity.
HOW IS OVERHEATING CONSIDERED IN THE HOUSEBUILDING PROCESS?
Health and housing – different conceptual frameworks and thresholds trigger action

Worrying about external or internal temperatures

‘The only time we’ve looked at [overheating] we’ve used CIBSE’s Guide A as the only thing out there that comes close to a definition.’
17. Does your organisation currently specify overheating-related requirements in your contracts with architects/designers?
**Regulations Compliance Report**

<table>
<thead>
<tr>
<th>Section</th>
<th>Details</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5 Cylinder insulation</strong></td>
<td>Hot water Storage: Nominal cylinder loss: 1.27 kWh/day Permitted by DBSCG: 1.70 kWh/day</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>Primary pipework insulated: Yes</td>
<td></td>
</tr>
<tr>
<td><strong>6 Controls</strong></td>
<td>Space heating controls: Programmer, TRVs and boiler energy manager</td>
<td>Fail</td>
</tr>
<tr>
<td></td>
<td>Hot water controls: Cylinderstat, Independent timer for DHW</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>Boiler interlock: Yes</td>
<td>OK</td>
</tr>
<tr>
<td><strong>7 Low energy lights</strong></td>
<td>Percentage of fixed lights with low-energy fittings: 100.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum: 75.0%</td>
<td>OK</td>
</tr>
<tr>
<td><strong>8 Mechanical ventilation</strong></td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td><strong>9 Summertime temperature</strong></td>
<td>Overheating risk (Thames valley): High</td>
<td>Fail</td>
</tr>
<tr>
<td></td>
<td>Based on:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overshading:</td>
<td>Average or unknown</td>
</tr>
<tr>
<td></td>
<td>Windows facing: South</td>
<td>5.5m²</td>
</tr>
<tr>
<td></td>
<td>Windows facing: North</td>
<td>6m²</td>
</tr>
<tr>
<td></td>
<td>Windows facing: South</td>
<td>6m²</td>
</tr>
<tr>
<td></td>
<td>Roof windows facing: Horizontal</td>
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<td></td>
<td>Ventilation rate:</td>
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<tr>
<td></td>
<td>Blinds/curtains:</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Air permeability:</td>
<td>2.5m²/m²</td>
</tr>
</tbody>
</table>

**Key features**

- Air permeability: 2.5m²/m²
Dynamic modelling used in some cases
Taking account of external factors

Arup, 2014
8. For those properties that have/have had overheating problems, how did your organisation find out there was a problem?

- Through our Building/Site Managers reporting problems (31%)
- Through customer surveys which specifically ask a question(s) about thermal comfort/overheating (41%)
- I don't know (10%)
- Through monitoring in the building or other post occupancy work (6%)
- Other (Please describe) (6%)
- Through un-solicited customer feedback/complaints (6%)
Stakeholder interviews

- Some great examples risk management
- Mixed perceptions on the extent of overheating
- Underlying ‘anxiety’
- When have housing providers done enough?
- Concern about expensive remedial work
Question

How can the construction and energy efficiency sector support housing providers in managing overheating risk for the benefit of their customers?
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Tackling overheating in homes
A review of solutions / prevention

Mich Swainson
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3rd March 2015
Overheating – understanding why?

– The heat balance is simple:
  – Heat in = heat out
  – Heat gains = heat losses
  – Heat gains = heat losses + heat rejected

– Heat balance in a building
  – Short term – hourly, daily
  – Long term – weekly or longer

– Thermal mass (storage of heat) modifies changes in temperature over short term.
Overheating - understanding why?

– The heat balance is simple:
  \[ \text{Heat gains} = \text{heat losses} + \text{heat rejected} \]

UK dwellings – not been a problem ….. well, maybe loft conversions …
Overheating - understanding why?

– The heat balance is simple:

Heat gains = heat losses + heat rejected

Non domestic – a different story – very low heat losses has for a long time required heat rejection to be considered
The heat balance is simple:

Heat gains = heat losses + heat rejected

But how do we reject heat from dwellings and most UK buildings?

Ventilation – natural or mechanically driven

Ventilation of buildings is for the provision of fresh air and removal of pollutants; moisture, odours, etc.

AD-F 2010 states:

Purge ventilation is intermittent, i.e. required only when such occasional activities occur. Purge ventilation provisions may also be used to improve thermal comfort, although this is not controlled under the Building Regulations.
Overheating – A review of solutions / prevention

- Review as wide a range of options to address the causes of overheating as possible
  - Solutions which limit heat gains

- Review the potential of as wide a range of options to reject heat as possible
  - Solutions which enhance heat rejection
  - Solutions which use cooling
  - Solutions based on occupant behaviour
Overheating – A review of solutions / prevention

– Solutions which limit heat gains
  – Urban heat island
    • Green spaces
    • Albedo – urban level
  – Local micro climate modification
    • Blue / green spaces – e.g. green roofs
    • Albedo - roof, etc.
  – Building micro climate modification
    • Green walls
    • Albedo – walls, etc.
  – Solar shading and glazing
    • Existing glazing types
    • Near market glazing types
  – Internal gains
Overheating – A review of solutions / prevention

- Solutions which enhance heat rejection
  - Natural ventilation
  - Mechanical ventilation
- Thermal mass
  - Attenuates rather than rejects heat
Overheating – A review of solutions / prevention

- Solutions which use cooling
  - Evaporative cooling
  - Ground loops
    - Ventilation air – earth tubes, etc.
    - Brine loops
  - District cooling
- Linked thermal mass or building structures and mechanical systems
- Mechanical cooling
Overheating – A review of solutions / prevention

- Solutions based on occupant behaviour
  - Evidence suggests that we are very poor at controlling building systems regularly to achieve a given aim, and many of the options open to occupant control are strongly influenced by personal preference, i.e. leaving windows open at night, etc.
Overheating – A review of solutions / prevention

– The levels of heat gains in single dwellings have changed little. In some residential blocks of flats, communal systems do result in the structure of the building becoming warm.

– The natural heat loss routes; building fabric, and infiltration, have been significantly reduced – the fabric first approach is working.

– Preventing, or providing solutions for overheating requires an understanding of the local and micro climates, and how these can be modified, and the massive potential opportunities to reject heat.

– There is no single action to prevent overheating in an energy efficient manner, designs must be reviewed and case studies of solutions established. The problem is here, now.
Tackling overheating in homes
A review of solutions / prevention

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3rd March 2015